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The Morphology of the Tasmantid Seamounts: Interactions between Tectonic Inheritance and Magmatic Evolution

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The Tasmantid seamounts extend for over 2000 km off the east coast of Australia and constitute one of three contemporaneous, sub-parallel Cenozoic hotspot tracks that traverse the region (the Tasmantid, Lord Howe, and East Australian volcanic chains), locally separated by as little as 500 km. Where dated, the three chains young from north to south, spanning ca. 34–6 Ma. At multiple locations, the Tasmantid chain intersects the extinct Tasman Sea spreading centre, which was active from 84 Ma to 53 Ma. Detailed morphological analysis reveals a strong correlation between tectonic setting, seamount orientation, and volcanic structure. Seamounts at inside corners of the spreading segment-transform intersections are more rugged and constructed via numerous intersecting fissure-fed volcanic ridges, whereas off-axis seamounts tend to be conical with summit craters and isolated dyke-fed flank cones.

In addition, the orientation of the Bouguer gravity anomaly highs, interpreted as magmatic conduits, and the long axes of the seamounts align closely with the principal stress directions expected for a ridge system in which strong mechanical coupling occurs across transform faults. Such a strong connection between the long-lived mantle upwelling, ridge structure, and subsequent dyke emplacement — despite the $\geq$ 20 Ma offset between spreading cessation and initial seamount emplacement — suggests deep faulting of the Tasman Sea oceanic lithosphere in order to channel melts along pre-existing structural trends.

Despite the large size of the edifices, up to $\sim$ 4000 m high, slope gradient and backscatter analysis along the chain point to sluggish mass wasting rates with few or no large sector collapse structures. In addition, most seamounts are associated with Bouguer gravity highs. Together, these features suggest that the seamounts have dense, coherent cores with high intrusive to extrusive volume ratios. This indicates low rates of melt generation and intra-lithospheric transport, implying that the thermal anomaly associated with the long-lived upwelling was relatively weak compared to the melting anomalies invoked for Hawaii, the archetypal plume-generated chain.